FORM PTO-1390 (Modified) (REV 10-95) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 1490

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): 09/980783

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/IL00/00347	13 June 2000	14 June 1999

TITLE OF INVENTION: METHOD FOR PRODUCING A DIGITALLY IMAGED SCREEN FOR USE IN A SCREEN PRINTING PROCESS

APPLICANT(S) FOR DO/EO/US: FIGOV, Murray

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 18 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
    A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☒ Other items or information:
    Article 34 Amendments were filed 6 August 2001 in response to a Written Opinion mailed 10 May 2001. These amendments are submitted herewith.

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/980783	PCT/IL00/00347	1490

19. The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :	CALCULATIONS PTO USE ONLY
Search Report has been prepared by the EPO or JPO	890
International preliminary examination fee paid to USPTO (37 CFR 1.482)	710
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))	740
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO	1040
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)	100
ENTER APPROPRIATE BASIC FEE AMOUNT =	1040.00
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☑ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	130.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	23 - 20 =	3	x 18.00	54.00
Independent claims	3 - 3 =	—	x 84.00	—.—
Multiple Dependent Claims (check if applicable).			☐	
TOTAL OF ABOVE CALCULATIONS			=	1224.00
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable).			☐	
SUBTOTAL			=	
Processing fee of $130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			+	
TOTAL NATIONAL FEE			=	1224.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).			☐	
TOTAL FEES ENCLOSED			=	1224.00
				Amount to be refunded: $
				charged: $

☑ A ~~check~~ credit card form in the amount of $1224.00 to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees.
A duplicate copy of this sheet is enclosed.

☐ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. _____. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Edward Langer
c/o Landon & Stark Associates
One Crystal Park
Suite 210, 2011 Crystal Drive
Arlington, VA 22202-3709
U.S.A.

SIGNATURE

Edward Langer
NAME

30,564
REGISTRATION NUMBER

4 December 2001
DATE

METHOD FOR PRODUCING A DIGITALLY IMAGED SCREEN FOR USE IN A SCREEN PRINTING PROCESS

FIELD OF THE INVENTION

The present invention relates to screen printing methods, and more particularly, to a novel method for the digital production of printing screens using ink jet printing technology.

BACKGROUND OF THE INVENTION

One of the most widely used methods of printing uses a screen. The basis of the screen is a woven thread with a net-like structure of holes. Early screens were fabricated from silk, but partly because of the expense of this material and partly from the point of view of performance, silk has been replaced by nylon, polyester or even metal. The screen is selectively blocked so that ink will pass through only in areas which are necessary to print. Screens come in a variety of mesh openings and thicknesses, depending on the particular application. The screen serves as a support for the blocking material, supporting portions of the blocking material which are unconnected and would otherwise be unsupported. For instance, in printing the letter 'O', in order to allow ink to form the

outside of the letter without filling the center, there must be blocking material in the center of the letter. The screen serves to support this center blocking material so that it cannot fall out of the stencil. The screen is tensioned on a frame and ink is pressed onto the stencil with a squeegee so that it is applied to a substrate placed below the screen in those places where it is necessary to print.

The screen printing process is used with inks formulated to adhere to a large variety of surfaces, and the printing process itself can handle a large variety of shapes. This makes screen printing the most versatile of printing processes and it is widely used to print on textiles, packaging, china-ware, glass, plastics, wood and metals, printed circuit boards and posters.

In order to make a screen, it is necessary to prepare artwork, then to photograph it to produce a positive film that in turn can be used to produce the exposed pattern on the photosensitive screen coating. Such original artwork may now be most easily prepared using a computer. The digital information in the computer is then used in an image-setter to produce the positive film. There are a variety of prior art photographic methods of producing the stencil.

In the direct method, solutions of light-sensitive coatings are applied directly onto the screen, then dried and hardened into a printing pattern by exposure to ultraviolet (UV) light through a positive film in which the image areas are opaque to UV light. After exposure, the unexposed, unhardened coating is washed away allowing ink to pass through.

There are other, indirect methods of producing the stencil. The light sensitive coating may be prepared as a pre-sensitized film on an intermediate base. The film can then either be transferred onto the screen before exposure and development or after exposure and development.

There is a growing need in many markets to print low run lengths and print on demand. This is because it is expensive to carry large stocks of pre-printed items and because there is an increasing demand for product customization to the need of individual customers or to relatively small groups of customers instead of mass production. The speed and cost of screen production becomes important and any means of simplifying and reducing costs is advantageous. There is also a trend to use computers to prepare artwork for printing and it would obviously be more convenient if the screen could be prepared directly from the computer information without recourse to the preparation of an intermediate photomask.

Inventors have attempted to use inkjet to produce masks on the screen itself, so that the unimaged, unprotected parts of the screen can be flood-cured by UV radiation. An example of this is described in EP 0 492 351 B1 by Gerber Scientific Products Inc. The problems of ink receptivity of the screen are acknowledged and the preferred method of overcoming these problems is by the introduction of talc onto the surface of the screen, to absorb the ink-jetted ink. This absorbs the liquid medium of the ink, to give a dried graphic. The graphic is described as preferably formed from a water-soluble ink.

Subsequently, similar inkjet integral masks have also been used to produce flexo plates. WO 97/25206 (Polyfibron) describes such a method. The inks used are either

solvent based or "phase change". After deposition, the ink is dried by evaporation of the volatile solvent or, in the case of phase change inks, by solidification. After the ink mask is used by flood-exposing the plate with UV light, the image areas are washed out. No mention is made of any difficulties in removing the dry mask after flood-exposure, save to point out that inks are useful so long as they can be removed by subsequent washing, without damaging the surface of the plate.

The following later patents recognize the problem of post flood-curing washout and try to deal with it. PCT WO 98/51750 (Markem Corporation) describes such a process. The inks used are "phase change" – known also as hot-melt inks. The ink dries by solidification as it impacts the screen. The patent recognizes the difficulty of removing the solid ink after it had served its purpose as a mask and the inks are formulated to be auto-dispersible in water.

GB 2 315 076 (Sericol) recognizes the same problem when phase change inks are used as integral masks for screen printing. Their solution is to use a water-soluble material having a wax-like texture.

US 5,878,076 (McCue) attempts to circumvent the problem of mask removal after UV flood-exposure by depositing only the screen itself by, for instance, inkjet, so that the deposit is in all areas except those of the image. The deposit is then subsequently flood UV-cured from both sides. As a layer of inkjet ink is relatively thin, the patent provides the possibility of multiple passes to achieve the desired screen thickness.

Therefore, it would be desirable to provide a method for screen printing which would not require the production of an intermediate positive film, would allow screen masters to

be imaged directly from digital information in the computer so as to simplify the known work flow of the printing process, would provide an easily washable ink for forming the mask and would be quicker and more economical to use.

SUMMARY OF THE INVENTION

Accordingly, it is a broad object of the present invention to overcome the problems of the prior art and provide a method of producing a digital screen directly from digital information in the computer in an economical fashion. Specifically, the invention seeks to overcome the problems of providing optimum ink-screen surface interaction to produce a high quality inkjet mask, together with very easy removal of the mask after it has fulfilled its masking function and to provide screen formulations that make this possible.

In accordance with a preferred embodiment of the present invention, there is provided a method of producing a screen using digital imaging, said method comprising the steps of:

providing digital image information from a computer system;

providing an image-ready printing blank comprised of a screen coated with a photosensitive coating that permits aqueous-based inkjet ink to be deposited evenly on its surface and remain in liquid condition;

printing said digital image information in UV-blocking aqueous-based inkjet ink on said photosensitive coating with an ink-jet printer, forming an image structure having exposed and unexposed areas of said photosensitive coating;

flood-curing said photosensitive coating having said formed image structure with UV light such that said exposed areas of said photosensitive coating are cured while said unexposed areas of said photosensitive coating are blocked from UV curing by said UV-blocking ink; and

washing said photosensitive coating so that said UV-blocking ink and said unexposed image structure areas are removed,

such that the remaining cured areas of said photosensitive coating form a mask on said screen for use in the screen printing process.

In accordance with another aspect of the invention there is provided a screen printing blank usable in a screen printing process, said printing blank comprising:

an image-ready printing blank comprised of a screen coated with a photosensitive coating that permits aqueous-based inkjet ink to be deposited evenly on its surface and remain in liquid condition.

In a preferred embodiment, a screen is provided with a photosensitive coating, and a digitally determined image from a computer is printed on the screen by means of an inkjet printer. It is preferable to use a flat bed ink-jet imaging system so that the screen can be stretched in a frame and directly placed under the ink-jet head. The ink used need not have strong colorant, but functions as a UV mask and thus must contain a UV absorbing pigment. The ink is not absorbed into the photosensitive coating, but remains as an undried image on the surface. The ink must remain wet so that that it does not spread and therefore gives a sharp image, and so that the UV absorbent material remains concentrated The screen is then irradiated with UV, and the areas which have been printed with ink serve to mask the photosensitive coating from the UV light, while those areas having no ink are exposed so that the photosensitive coating is polymerised by the UV.

After the UV irradiation stage, the screen is washed so as to remove the ink and the unpolymerised photosensitive coating. Any liquid that is suitable for washing out the unpolymerised photosensitive coating will also wash away the ink. This leaves the screen with only the polymerised areas of the photosensitive coating that create the blocked areas through which the ink will not pass.

Thus, the inventive method provides a digitally imaged screen, directly from a digital image in the computer, which can then be used in any conventional screen printing process.

Other features and advantages of the invention will become apparent from the following drawings and descriptions.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention with regard to the embodiments thereof, reference is made to the accompanying drawings, in which like numerals designate corresponding elements or sections throughout and in which:

Fig. 1 shows a diagramatic representation of a prior art method of the silk-screen printing process;

Figs. 2a-c depict cross-sectional views of the stages of the prior art method of producing a stencil photographically, previously described as the direct method;

Figs. 3a-e depict cross-sectional views of the stages of the prior art method of producing a stencil photographically, previously described as an indirect method where transfer from an intermediate material to the screen is done after imaging and washing out;

Figs. 4a-d depict cross-sectional views of the stages of the prior art method of producing a stencil photographically, previously described as an indirect method where transfer from an intermediate material to the screen is done before the imaging and washing stages;

Fig. 5 shows a photosensitive screen stencil which has been imaged and washed out according to one of the above described prior art procedures; and

Figs. 6a-e show cross-sectional views of the steps of the process of producing a stencil, in accordance with the method of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The following description begins with a review of prior art methods, shown in Figs. 1-5.

To print in the screen printing method, as shown in prior art Fig. 1, stencil 20 may be used for printing after being tensioned in a metal or wooden frame 22 and having substrate 24 placed beneath it. Stencil 20 must be selectively blocked so that ink 26 can pass through onto the printing substrate 24 only in the areas which are necessary to print. For the simplest type of work, this may be achieved by cutting stencil 20 from a laminated film material and then applying it to screen 28. Ink 26 is pressed onto stencil 20 with squeegee 27 so that ink 26 passes through the unblocked areas of screen 28 onto substrate 24, while ink 26 does not pass through the areas of screen 28 which are blocked by stencil 20.

As mentioned above, the prior art method of producing artwork for silk-screen printing often requires photographing the material. There are a variety of photographic methods of producing stencil 20. A prior art method known as the direct method is shown diagramatically in prior art Figures 2a-c. These figures show cross-sectional views of the structures of screen printing stencils.

As seen in Fig. 2a, stencil 20 is formed by screen 28 to which solutions of light sensitive coatings 30 are applied. Screen 28, represented by cross lines, is filled with photosensitive coatings 30, which are then dried. Positive film 32 is laid on stencil 20. Positive film 32 is comprised of black, UV-opaque image areas and clear, UV-transparent background, or non-image areas, and functions as a UV mask in contact with stencil 20.

Positive film 32 is comprised of black, UV-opaque image areas and clear, UV-transparent background, or non-image areas, and functions as a UV mask in contact with stencil 20.

Figure 2b shows the exposure of the combination of film image 32 and stencil 20 to flood UV light. Coatings 30 are selectively hardened into a printing pattern by exposure to UV light through positive film 32 in which the image areas are opaque to the UV light. UV light penetrates film image 32 in the non-image areas and cures the corresponding areas of photosensitive coating 30 creating cured, cross-linked polymeric material 34.

Film image 32 is then physically removed and screen 28 is washed with a solvent, which may be water. As seen in Fig. 2c, the washing removes the uncured areas of photosensitive coating 30 leaving only the open woven mesh of screen 28 in these areas, while retaining cross-linked polymeric material 34. Stencil 20 may then be used for printing as described in Fig. 1.

There are other, indirect methods of producing the stencil. The light sensitive coating may be prepared as a pre-sensitized film on an intermediate base. The film can then either be transferred onto the screen before exposure and development or after exposure and development.

Prior art Figures 3a-e show cross-sectional views of an indirect method of transfer from an intermediate material to the screen after the imaging and washing stages. Figure 3a shows the donor sheet, characteristically a UV transparent substrate 36, comprised of a material such as polyester, coated with a photosensitive coating 38. A positive film serves as photomask 40 and is laid in contact with coating 38. Figure 3b depicts a UV

exposure through photomask 40 onto coating 38. Where the UV is not blocked by photomask 40, coating 38 is hardened by polymerisation. The areas of coating 38 which were directly under the UV opaque areas of photomask 40 remain unaffected. Photomask 40 is then physically removed and the surface of coating 38 is washed, usually with either an organic solvent or a weak alkali solution. This solution washes out the unpolymerised areas, leaving the polymerised areas of coating 38 as depicted in Figure 3c. Coating 38 is then pressed in contact with screen 28 as shown in Figure 3d and either by means of pressure, heat or solvent, is transferred to the screen as shown in Figure 3e, thus providing areas in which the ink is blocked, for the screen printing process.

Prior art Figures 4a-d describe an indirect transfer process where transfer from an intermediate material to the screen is done before the imaging and washing stages. Figure 4a shows support 42 coated with photosensitive coating 38 being pressed together with the screen 28, so as to transfer the photosensitive material to screen 28. As in Fig. 3, the transfer may be affected either by heat or pressure or a combination of these, or by solvent, possibly combined with heat and pressure. Support 42 is then physically peeled away and the resulting screen is shown in Fig. 4b. UV flood exposure through photomask 40 is shown in Fig. 4c. This cures the areas which are not blocked by photomask 40. After subsequent washing, as previously described, a print-ready screen results, as shown in Fig. 4d.

Fig. 5 shows a photosensitive screen stencil which has been imaged and washed according to one of the above described procedures. The image areas show the exposed screen through which ink may pass during printing.

Referring now to Figs. 6a-d, which describe the present invention. Fig. 6a shows screen 28 with a photosensitive coating 38 coated within the screen.

Fig. 6b shows an ink jet head 44 jetting aqueous inkjet ink 46 onto the surface of photosensitive coating 38 of screen 28. The system shown is, by way of example, a generic impulse (drop-on-demand) system, although any type of ink jet system is usable in this invention. In this system, ink supply 48 is delivered at atmospheric pressure. Piezo-electric crystal 50 produces a pressure wave along arrow "A" upon actuation by an electric signal. This pressure wave causes the ejection of a droplet of inkjet ink 46 from ink-jet nozzle 52. A data pulse train 54 produces a pattern of dots as ink-jet head 44 traverses the surface of screen 28 depositing image 56.

Thus, inkjet ink 46 is deposited in a pattern that is digitally determined to provide the information directly from a computer that will be printed by the screen by a conventional screen printing process. It is essential to the invention that inkjet ink 46 is not absorbed into the photosensitive coating, but remains as an undried image on the surface. This has various advantages which will be explained below. It is also essential that the surface of photosensitive coating 38 has suitable wetting properties so that when ink droplets 46 impact the surface, they provide smooth, even contact without excessive spreading and without reticulation.

Figure 6c shows the imaged screen being irradiated with UV radiation. In this case, inkjet ink 46 forms a barrier to the radiation. Preferably, it contains carbon black as the UV absorbing pigment, but dyes or pigments with strong absorption in the UV region may also be used. Ink 46 need have very little actual colorant that is evident to the naked

eye, just a sufficient amount to make it visible for following the imaging procedure. The UV absorption function of the dye is more important. As the ink remains wet and is not absorbed into photosensitive coating 38 but remains on the surface, the ink does not spread into coating 38 and therefore gives a sharp image with concentrated pigment or dye or other UV absorbent material. Where there is no inkjet image 56, the radiation polymerizes photosensitive coating 38 and thus reduces its solubility in the developing liquid.

As seen in Fig. 6d, the next stage of the inventive process is to wash out the unpolymerised photosensitive coating 38 together with the ink jet image. Because the inkjet image is wet, it is easily removed by any liquid that is suitable for washing out the uncured coating. Preferred liquids are weak aqueous alkali solutions such as sodium carbonate dissolved in water or mixtures of water with surfactants and other additives such as organic solvents (generally less than 20% of the developer by weight). This leaves the screen 28 with only the hardened areas of photosensitive coating 38 that create the blocked areas through which ink will not pass.

As seen in Fig. 6e, after washing, the screen may undergo a further UV hardening stage to increase resistance to any solvents that may be used in inkjet ink 46.

Generally, it is preferable to have a flat bed ink-jet imaging system so that the screen that is stretched in a frame can be directly placed under the ink-jet head. The wet imaged screen is then exposed by transferring the frame so that it resides horizontally below a UV exposure unit that irradiates the surface of the imaged screen from above.

Washing of the exposed screen can be accomplished with the solutions recommended by the screen manufacturer.

The preferred type of composition of photosensitive coating 38 has the following three components:

1. Component (A) -- between 35% and 75% by weight: UV-curable resins, i.e. oligomers and monomers that can be cross-linked, in the presence of a photoinitiator, by means of irradiation with ultra violet light.

2. Component (B) -- up to 10% of the weight of component (A): photoinitiators and synergists that will generate and promote free radicals needed for the cross-linking reaction of component (A).

3. Component (C) -- from 10% to 50% by weight: binder resins that must be soluble in water or dilute alkali, as well as in non-aqueous (organic) solvents. It has been found that due to the presence of the binder resin, the surface of the uncured film is particularly suitable for printing with aqueous ink jetinks.

In addition, there are optional ingredients, such as fillers and wetting agents, as well as dyes or pigments to aid visual examination of photosensitive coating 38. The entire mixture may be coated from a non-aqueous solvent directly onto screen 28. Preferably, it is deposited onto a release coating either on paper or film and either in a partially dry state or in a hot and sticky state screen 28 is pressed onto the coating so that after drying and cooling photosensitive coating 38 is absorbed and bonded into the surface of the screen 28 as shown in Figure 4C. Coating thickness preferably is 20 microns, but can be between 10 microns and 60 microns, in order to obtain maximal

difference in solubility between cured and uncured regions and optimise print quality and screen robustness.

The three components of photosensitive coating 38 preferably consist of materials showing suitable duality of solubility in both aqueous and non-aqueous solvents. This would exclude resins such as polyvinyl chlorides, which may be soluble in organic solvents but not in water, and polyvinyl alcohols, which are not soluble in non-aqueous solvents. The resin system used for component (C) must be soluble in organic solvents, so that the monomers and oligomers of component (A), as well as the photoinitiators of component (B), will dissolve easily and, upon application, will yield a compatible dry film. The resins must also have aqueous solubility so that the uncured coating provides suitable inkjet receptivity and can also be washed away, as described below.

Although it would be possible to make a system where the layer is washed away with an organic solvent, this is environmentally not desirable. Examples of types of resins that are useful in the system are Novalaks (functionally substituted phenol-formaldehyde resins), styrene maleic anhydride copolymers, polyvinyl methyl ether/maleic anhydride copolymer and its esters, hydroxy propyl cellulose and esterified rosin-maleic esters and maleic resins with acid values of at least 50.

The following is an example of the components used in screen blank fabrication, imaging and treatment to produce a finished screen.

EXAMPLE I

The following composition was made up (parts by weight) and milled in a ball mill for 2 hours;

Methyl Ethyl Ketone	205 parts
Kaolin	34 parts
Ebecryl 150	20 parts
Cab-O-Sil M5	8.6 parts

After milling, the following ingredients (all parts by weight) were added and stirred in, one by one.

Scripset 550	21 parts
Ebecryl 1259	110 parts
Alsynol RC 12	25 parts
Irgacure 184	2.8 parts
Irgacure 907	4.3 parts
Speedcure ITX	1.14 parts
BYK 307	1.32 parts
Sudan Black B	0.17 parts

The mixture was bar coated onto a silicone coated release paper. The mixture was air dried for 30 seconds and a commercially available woven polyester fabric suitable for graphics arts printing was pressed onto the coating. As the coating still retained solvent, the polyester fabric penetrated the surface. The sandwich was then dried at 140°C for 2 minutes to give a dry weight of coating of the above formulation of 25 grams per square meter. By this process, this coating was firmly bonded onto the surface of the polyester fabric.

The coated fabric was then tensioned in a frame and placed on an XY bed where it was imaged using the inkjet printhead described in Patent No. EP640481 assigned to Scitex. The ink used in this head was Epson ink, coded SO20010.

The imaged screen was then exposed to a UV source and then developed by washing with a solution of the following composition;

Deionised water	1050 g
Sodium carbonate	6.6g
Benzyl alcohol	12.0g
Sodium lauryl sulphate	5.4 g

The washing solution removed the ink as well as the unhardened photopolymeric coating. The screen was then further hardened by UV exposure and could then be used for conventional screen printing.

SOURCES OF TRADE NAMED RAW MATERIAL

Alsynol RC12 Rosin-maleic resin esterified with pentaerithritol. Manufactured by DSM 3150 AA Hoek van Holland.

BYK 307 Polyether modified polydimethyl siloxane. Manufactured by BYK-Gardner GmbH, Geretsried, Germany.

CAB-O-JET 200 Aqueous dispersion of carbon black. Manufactured by Cabot Corporation, Billerca, Massachusetts, US.

Cab-O-Sil M5 Fumed silica. Manufactured by Cabot Corporation, Billerca,

Massachusetts, US.

Ebecryl 150 Bisphenol A derivative of diacrylate oligomer. Manufactured by UCB Chemicals, Basle, Switzerland.

Ebecryl 1259 Aliphatic trifunctional urethane acrylate diluted with 35% hydroxy propyl methacrylate. Manufactured by UCB Chemicals, Basle, Switzerland.

Irgacure 184 1-hydroxy-cyclohexyl-phenyl-ketone. Manufactured by Ciba Geigy Corporation, CH-4002, Basle, Switzerland.

Irgacure 907 2-Methyl-1[4-(methylthio)phenyl}-2-morpholino-propan-1-one. Manufactured by Ceba-Geigy Corporation, CH-4002, Basle, Switzerland.

Scripset 550 Secondary butyl ester of styrene-maleic anhydride copolymer. Manufactured by Solutia Europe NV/S.A. Louvain-La-Neuve(Sud), Belgium.

Speedcure ITX Isopropylthioxanthone. Manufactured by Lambson, Castleford, UK.

Sudan Black B Dye. Manufactured by BDH Laboratories, Poole, Dorset, England

Q2-5211 Super-wetting agent. Manufactured by Dow Corporation, Midland, MI, USA.

Having described the invention with regard to certain specific embodiments thereof, it is to be understood that the description is not meant as a limitation, since further modifications may now suggest themselves to those skilled in the art, and it is intended to cover such modifications as fall within the scope of the appended claims.

Claims:

1. A method of producing a screen using digital imaging, said method comprising the steps of:

providing digital image information from a computer system;

providing an image-ready printing blank comprised of a screen (28) coated with a photosensitive coating (38) that permits aqueous-based inkjet ink (46) to be deposited evenly on its surface and remain in liquid condition;

printing said digital image information in UV-blocking aqueous-based inkjet ink (46) on said photosensitive coating (38) with an ink-jet printer (44), forming an image structure having exposed and unexposed areas of said photosensitive coating;

flood-curing said photosensitive coating (38) having said formed image structure with UV light such that said exposed areas of said photosensitive coating (38) are cured while said unexposed areas of said photosensitive coating (38) are blocked from UV curing by said UV-blocking ink (44); and

washing said photosensitive coating (38) so that said UV-blocking ink (44) and said unexposed image structure areas are removed,

such that the remaining cured areas of said photosensitive coating (38) form a mask on said screen (28) for use in the screen printing process.

2. The method of claim 1 further comprising the step of flood-curing said photosensitive coating with UV radiation after said washing step.

3. A method of producing a screen print using digital imaging, said method comprising the steps of:

producing a digitally imaged screen in accordance with the method of claim 1, and

using said digitally imaged screen in a screen printing process.

4. The method of claim 1 wherein said ink-jet printer is a flat-bed imaging system.

5. The method of claim 1 wherein said ink-jet printer is part of a generic impulse system.

6. The method of claim 1 wherein said ink-jet printer is part of a continuous ink-jet system.

7. The method of claim 1 wherein said wash is an aqueous alkali solution.

8. The wash of claim 7 wherein said wash comprises aqueous sodium carbonate.

9. The wash of claim 7 wherein said wash comprises less than approximately 20% organic solvents.

10. A screen printing blank usable in a screen printing process, said printing blank comprising:

an image-ready printing blank comprised of a screen (28) coated with a photosensitive coating (38) that permits aqueous-based inkjet ink (46) to be deposited evenly on its surface and remain in liquid condition.

11. The printing blank of claim 10 wherein said photosensitive coating comprises wetting agents.

12. The printing blank of claim 10 wherein said photosensitive coating is between approximately 10 and 60 microns in thickness.

13. The printing blank of claim 10 wherein said photosensitive coating is approximately 20 microns in thickness.

14. The printing blank of claim 10 wherein said photosensitive coating comprises UV-curable resins, photoinitiators, synergists and binder resins.

15. The printing blank of claim 14 wherein said UV-curable resins are present as between approximately 35%-75% by weight of said photosensitive coating.

16. The printing blank of claim 14 wherein said photoinitators and synergists are present as up to approximately 10% of the weight of said UV-curable resins.

17. The printing blank of claim 14 wherein said binder resins are present as approximately 10%-50% by weight of said photosensitive coating.

18. The printing blank of claim 14 wherein said binder resins are soluble in both aqueous and non-aqueous solvents.

19. The printing blank of claim 10 wherein said photosensitive coating comprises at least one of dyes and pigments which are added to aid visual examination of said coating.

20. The printing blank of claim 14 wherein said binder resins include at least one of novalak, styrene maleic anhydride copolymers, polyvinyl methyl ether/maleic anhydride copolymer and its esters, hydroxy propyl cellulose and esterified rosin-maleic esters, and maleic resins with acid values of at least 50.

21. The printing blank of claim 10 wherein said ink remains wet during the imaging process and is not absorbed into said photosensitive coating.

22. The printing blank of claim 10 wherein said ink is comprised of carbon black.

23. The printing blank of claim 10 wherein said ink is comprised of a UV absorbing pigment or dye.

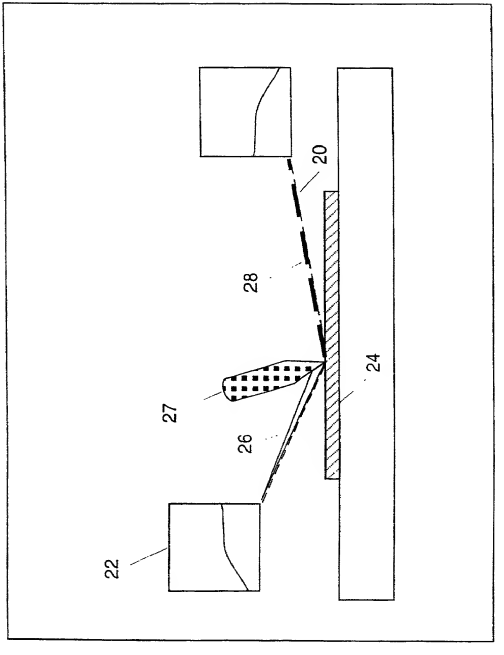

FIG. 1

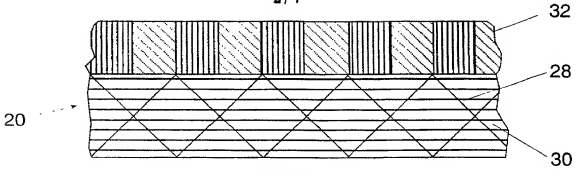

FIG. 2A

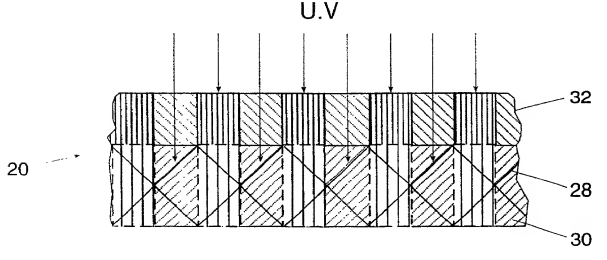

FIG. 2B

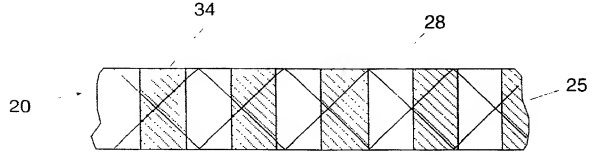

FIG. 2C

FIG. 2- PRIOR ART
Direct Method of Producing Screen

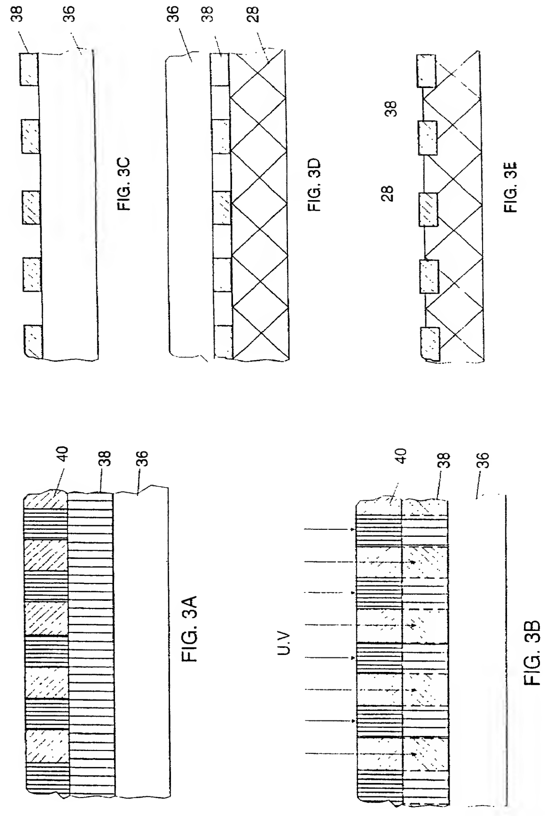

FIG. 3- PRIOR ART
Indirect Method (a)

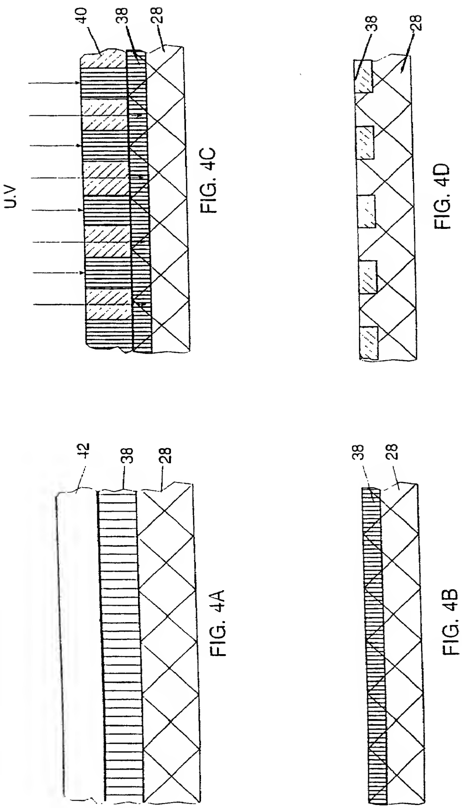

FIG. 4- PRIOR ART
Indirect Method (b)

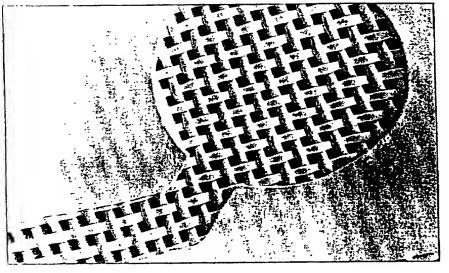

FIG. 5

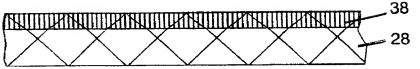

FIG. 6A

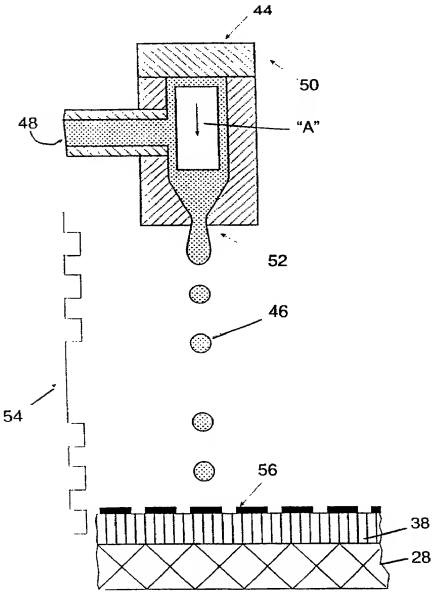

FIG. 6B

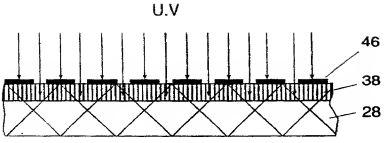

FIG. 6C

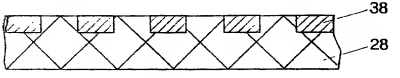

FIG. 6D

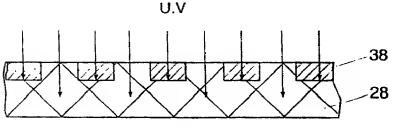

FIG. 6E

Please type a plus sign (+) inside this box → [+]

PTO/SB/01 (12-97)
Approved for use through 9/30/00. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	1490
First Named Inventor	FIGOV, Murray
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD FOR PRODUCING A DIGITALLY IMAGED SCREEN FOR USE IN A SCREEN PRINTING PROCESS

(Title of the invention)

the specification of which
☐ is attached hereto
OR
☒ was filed on (MM/DD/YYYY) [ ] as United States Application Number or PCT International Application Number [ ] and was amended on (MM/DD/YYYY) [ ] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

Please type a plus sign (+) inside this box → [+]

PTO/SB/01 (12-97)
Approved for use through 9/30/00. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)
PCT/IL00/00347		

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number [ ] → *Place Customer Number Bar Code Label here*
OR
☐ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number
Edward Langer	30,564		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] OR [X] Correspondence address below

Name	Edward Langer c/o Landon & Stark Associates				
Address	One Crystal Park Suite 210				
Address	2011 Crystal Drive				
City	Arlington	State	VA	ZIP	22202-3709
Country	U.S.A.	Telephone	(703) 486-1150	Fax	(703) 892-4510

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Murray	FIGOV

Inventor's Signature	M. Figov					Date	Jan. 6, 2002
Residence: City	Ra'anana	State	ILX	Country	ISRAEL	Citizenship	IL
Post Office Address	2/18 Schwartz Street						
Post Office Address							
City	SAME	State		ZIP	43213	Country	ISRAEL

☐ Additional inventors are being named on the ___ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto